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## (54) REFLECTION PLATE, REFLECTION TYPE LIQUID CRYSTAL DISPLAY DEVICE AND PRODUCTION THEREOF

(57)Abstract:

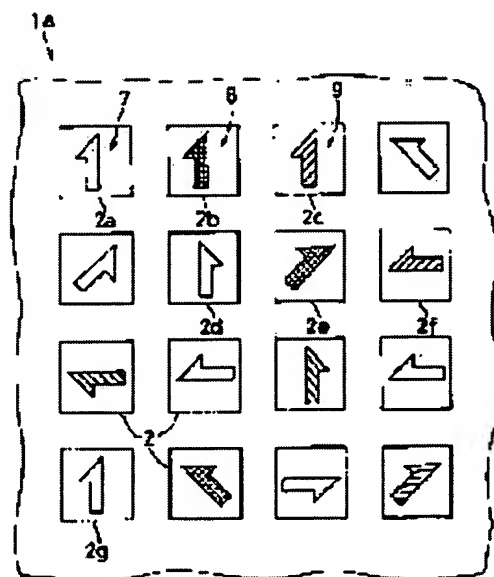
PROBLEM TO BE SOLVED: To provide a reflection plate having a satisfactory reflection characteristic and a reflection type liquid crystal display device improved in display quality.

SOLUTION: A mask 1a has plural kinds of ruggedness patterns equivalent to one pixel and at least one kind of the ruggedness pattern is present by plural pieces.

Either two patterns from among specific kinds of ruggedness patterns being present by plural pieces are

in one or two relations including at least a parallel translation from among the parallel translation, a rotational translation and a front/rear surface inversion and also are irregularly arranged. Even when exposures of plural times are performed while changing positions by

producing a reflection plate having a projection part and a reflection type liquid crystal display device while exposing a photosensitive resin film by using the mask 1a, a joint is not observed and even when the parallelism of incident light is high, a reference color is prevented from being generated and the reflection characteristic and a display characteristic are enhanced.



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CLAIMS

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[Claim(s)]

[Claim 1] It is the reflecting plate which the field corresponding to each pixel on this front face of a reflecting plate is concave convex, and is characterized by there being two or more kinds of concavo-convex patterns for 1 pixel in the reflecting plate used for the display of the light reflex mold which has two or more pixels arranged in the shape of a matrix.

[Claim 2] Any 2 patterns of the concavo-convex patterns of the specific class which at least one kind of concavo-convex pattern has more than one, and has more than one are reflecting plates according to claim 1 which are 1 or two or more relation of what carried out the parallel displacement mutually in the reflecting plate front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterized by being arranged in irregular.

[Claim 3] It has the insulating substrate of the pair arranged by intervening in a liquid crystal layer. Either to the liquid crystal layer side of an insulating substrate In the reflective mold liquid crystal display which reflects and carries out outgoing radiation of the light which carried out incidence with a pixel electrode from the another side insulation substrate side which two or more pixel electrodes which have light reflex nature arrange in the shape of a matrix, are arranged, and has translucency It is the reflective mold liquid crystal display which the front face of said pixel electrode is concave convex, and is characterized by there being two or more kinds of concavo-convex patterns for 1 pixel.

[Claim 4] Any 2 patterns of the concavo-convex patterns of the specific class which at least one kind of concavo-convex pattern has more than one, and has more than one are reflective mold liquid crystal displays according to claim 3 which are 1 or two or more relation of what carried out the parallel displacement mutually in the pixel electrode surface, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterized by being arranged in irregular.

[Claim 5] After forming the photopolymer film on the substrate which is the manufacture approach of the reflecting plate used for the display of the light reflex mold which has two or more pixels arranged in the shape of a matrix, and is defined beforehand, the mask which has a predetermined pattern is minded. In the manufacture approach of a reflecting plate including the process which exposes the photopolymer film said mask The manufacture approach of the reflecting plate characterized by having two or more kinds of patterns for 1 pixel, moving this mask or said substrate, and including the process to develop after carrying out the count loop of predetermined of the process which exposes said photopolymer film.

[Claim 6] Any 2 patterns of the concavo-convex patterns of the specific class which at least one kind of concavo-convex pattern of said mask has more than one, and has more than one are the manufacture approaches of the reflecting plate according to claim 5 which is 1 or two or more relation of what carried out the parallel displacement mutually in the mask front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and is characterize by to be arrange in irregular.

[Claim 7] It has the insulating substrate of the pair arranged by intervening in a liquid crystal layer. Either to the liquid crystal layer side of an insulating substrate Two or more pixel electrodes which have light reflex nature arrange in the shape of a matrix, and are arranged. It is the manufacture approach of the reflective mold liquid crystal display which reflects and carries out outgoing radiation of the light which carried out incidence with a pixel electrode from the another side insulation substrate side which has translucency. After covering a part of switching element [ at least ] formed on the insulating substrate on the other hand and forming the photopolymer film on this one side insulation substrate, the mask which has a predetermined pattern is minded. In the manufacture approach of a reflecting plate mold liquid crystal display including the process which exposes the photopolymer film said mask The manufacture approach of the reflective mold liquid crystal display characterized by including the process to develop after having two or more kinds of patterns for 1 pixel and carrying out the count loop of predetermined of this mask or said process which moves an insulating substrate on the other hand, and exposes said photopolymer film.

[Claim 8] Any 2 patterns of the concavo-convex patterns of the specific class which at least one kind of concavo-convex pattern of said mask have more than one , and have more than one be the manufacture approaches of the reflective mold liquid crystal display according to claim 7 which be 1 or two or more relation of what carried out the parallel displacement mutually in the mask front face , the thing which made it rotate , and the things which carried out front flesh side reversal which include a parallel displacement at least , and be characterize by to be arrange in irregular .

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[Translation done.]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention is used for the display of a matrix mold, and relates to the reflective mold liquid crystal display which does not use the back light which displays by reflecting incident light in a pixel electrode surface, and its manufacture approach, concerning the reflecting plate and its manufacture approach for reflecting incident light.

[0002]

[Description of the Prior Art] Since the back light which is the light source is unnecessary, the reflective mold liquid crystal display which displays from the outside also in a liquid crystal display by reflecting the light which carried out incidence has low power consumption, and is a thin shape, and it is observed by lightweight-ization being attained. In order to obtain a still brighter display with a reflective mold liquid crystal display, the formation technique of a reflecting plate of having irregularity is important for the front face which needs to create the reflecting plate to which the luminous intensity scattered about in the direction of a watcher can be made to increase to incident light, and which has the optimal reflection property, and a paper white can realize.

[0003] The technique which forms irregularity on the surface of a reflecting plate with a photopolymer is indicated according to the photograph process by JP,5-323371,A. Drawing 9 is the top view showing the configuration of mask 1b of the conventional technique used in order to form irregularity on the surface of a reflecting plate. Drawing 9 (a) is the top view of mask 1b showing 61 [ 1-pixel ]. Drawing 9 (b) is drawing showing the arrangement relation of the unit pattern of mask 1b.

[0004] It is designed so that it may become irregular arrangement (random) of about 200 circular fields 62 in order to form the irregularity of mask 1b for the configuration of 61 to control 1 pixel of interference of the reflected light for example. The die length 63 of each side is the rectangle which is 100 micrometers - 1000 micrometers, and 61 expresses 1 pixel of the unit pattern with a notation 64. By repeating the unit pattern expressed with a notation 64 using mirror plane reversal, mask 1b opts for arrangement of the whole irregularity, and is designed.

[0005] Next, the production process of a reflecting plate which has irregularity is explained using mask 1b. Drawing 4 is a perspective view for explaining the exposure process in the manufacture approach of a common reflecting plate. The photopolymer film 17 is formed on the substrate 10 defined beforehand. The spherical exposure lamp 18 of stepper equipment is arranged in the photopolymer film 17 side upper part of a substrate 10, and the photopolymer film 17 is exposed through a mask 1. Since it is the case where diagonal length is about 12.7cm or less at the maximum in the present condition, when diagonal length creates reflecting plate about 12.7cm or more depending on the magnitude of the exposure lamp 18, the area which can be irradiated by one exposure moves the location of a mask 1 or a substrate 10, and repeats an exposure process the number of predetermined times. For example, the exposure side A is exposed by one exposure in a substrate 10. Then, different exposure side B-H is exposed by the target one by one by moving a mask 1 or a substrate 10, respectively. In the circular field 62 which mask 1b of the conventional technique used as a mask has, the field of the photopolymer film

[ / in addition to circular field 62 ] 17 is exposed by considering as the optical protection-from-light section.

[0006] The cylinder section will be formed in the field corresponding to the circular field 62 if the photopolymer film 17 after exposure is developed using a developer. The rough edge of the character of this cylinder section is rounded off by heat-treating at 120 degrees C - 250 degrees C, and it turns into heights with a smooth front face. The light reflex film which furthermore covers heights and consists of a metal thin film all over a substrate 10 is formed. Of heights, the light reflex film has a continuous curved surface, and is formed in the shape of [ of conic loose boom hoisting ] toothing. Thus, the luminous intensity which turns on a watcher increases the reflecting plate which has the shape of formed toothing, and when it uses for a reflective mold liquid crystal display, a paper white's bright display is obtained.

[0007]

[Problem(s) to be Solved by the Invention] 61 [ 1-pixel ] is used as a unit pattern, and mask 1b of the conventional technique is designed by [ which have the circular field 62 as mentioned above ] carrying out mirror plane reversal and repeating this unit pattern. Heights are formed in a reflecting plate of such mask 1b, and, as for the reflective mold liquid crystal display using this reflecting plate, a bright display is obtained in a paper white. However, by exposing two or more times, when a reflecting plate is large-sized, a reflection property falls and display grace falls with a display. The detail is explained below.

[0008] Drawing 10 is drawing showing exposure intensity distribution with the exposure lamp 18 of stepper equipment. It is expressed by the high line 24, such as expressing boom hoisting of the crest where a part with strong exposure reinforcement and a weak part are gently-sloping, by connecting with a curve the point that the exposure reinforcement of the field 23 which can be exposed is equal.

Exposure reinforcement becomes so weak [ it is so strong that an arrow head 25 progresses to a field 26 side, and ] that it progresses to a field 27 side. Since dispersion in about 3% of exposure reinforcement exists in the field 23 which can be exposed according to the difference of such exposure reinforcement, exposure nonuniformity arises.

[0009] Drawing 11 is drawing showing the optical intensity distribution at the time of changing a location and performing multiple-times exposure. For example, it exposes in order of the exposure sides A, B, C, and D, respectively. In exposure of Field A, although exposure reinforcement changes gently-sloping, when a location is changed and two exposure or more is performed, the exposure reinforcement of each joint 28 of a field and a field will change rapidly. The abrupt change of exposure reinforcement is observed as exposure nonuniformity.

[0010] Drawing 12 is the perspective view showing the difference in the configuration of the heights 21 by exposure reinforcement. Drawing 12 (a) shows the case where exposure reinforcement is strong, and drawing 12 (b) shows the case where exposure reinforcement is weak. Each cylinder section 20 formed in the front face of a substrate 10 becomes so thin that exposure reinforcement is strong. By heat-treating the cylinder section 20, the rough edge of the character is rounded off, and the projected part 21 with a smooth front face is formed. If [ height d of each heights 21 ] the same, its inclination is so sudden that the configuration of heights 21 has strong exposure reinforcement, and it is so gently-sloping that exposure reinforcement is weak. [ of inclination ] Thus, the configuration of heights 21 changes with exposure nonuniformity.

[0011] Drawing 13 is a graph which shows the difference in the reflection property of the heights 21 by exposure reinforcement. Drawing 13 (a) shows the case where exposure reinforcement is strong, and drawing 13 (b) shows the case where exposure reinforcement is weak. An axis of abscissa expresses whenever [ azimuth ] and the axis of ordinate expresses reflectivity. From a weak place, since the configuration of heights 21 changes, the place where exposure reinforcement is strong differs in reflectivity. The place where exposure reinforcement is strong has a small change of reflectivity over the large viewing-angle range, and, specifically, as for the place where exposure reinforcement is weak, change of the reflectivity in viewing-angle within the limits is large.

[0012] Drawing 14 is drawing showing change of the reflection property of the reflecting plate 71 at the time of changing a location and exposing multiple times using the conventional mask 1b. Drawing 14

(a) shows the pattern of a reflection property, and drawing 14 (b) shows the reflection property of the exposure side A and the exposure side B. Change of reflectivity is in the smallest condition, and a sign 65 expresses the condition that change of reflectivity becomes large gradually as it progresses to signs 66, 67, and 68. The exposure sides A and B are formed of two or more pixels 61 which have a reflection property as shown with signs 65-68. A broken line 69 is a high line, such as expressing exposure intensity distribution with said exposure lamp 18. Field 69a is a field where light exposure is strong, and light exposure becomes weak as it goes to Fields 69b and 69c. For example, the field A is exposed by the 1st exposure. In one exposure, since the shape of tothing changes gently-sloping continuously and a reflection property changes gently-sloping similarly in connection with it corresponding to the exposure nonuniformity shown with a broken line 69, the display nonuniformity by the interference color is not observed.

[0013] However, when exposure of multiple times, such as Field A and Field B, is performed, at the joint 70 of Field A and Field B, a concavo-convex configuration also changes with the abrupt changes of exposure reinforcement rapidly, for example. Consequently, since a reflection property changes rapidly at a joint 70, when the difference of a reflective distribution property displays by becoming the nonuniformity of brightness and being observed, the part of a joint 70 serves as a line, it is observed, and display grace falls.

[0014] Drawing 15 is drawing showing a reflection property when the parallelism of incident light is high in the conventional reflecting plate 71. Since the shape of tothing 72 and a reflection property serve as a repetition of the same pattern, when the parallelism of incident light is high, the parallelism of the reflected light also becomes high, the interference color by this reflected light is observed by repetition of a unit pattern with mask 1b same [ each pixel 61 of a reflecting plate 71 ], and display grace falls remarkably by it.

[0015] The purpose of this invention is offering the manufacture approach of offering the reflecting plate which solves an above-mentioned problem and has a good reflection property and offering the manufacture approach of this reflecting plate, the reflective mold liquid crystal display whose display grace's improves further, and this reflective mold liquid crystal display.

[0016]

[Means for Solving the Problem] In the reflecting plate with which this invention is used for the display of the light reflex mold which has two or more pixels arranged in the shape of a matrix, the field corresponding to each pixel on this front face of a reflecting plate is concave convex, and the concavo-convex pattern for 1 pixel is a reflecting plate characterized by there being two or more kinds. If this invention is followed, a reflecting plate is used for the display of the light reflex mold which has two or more pixels arranged in the shape of a matrix, and the luminous intensity scattered about in the direction of a watcher can be made to increase to incident light by forming the front face corresponding to each pixel in concave convex. Moreover, when there are two or more kinds of concavo-convex patterns for 1 pixel, the abrupt change of a reflection property can be prevented and a joint does not occur. Moreover, since the reflection properties of each pixel differ even when the parallelism of incident light is high, interference of the reflected light can be prevented and a good reflection property can be obtained. When it uses for the display of a light reflex mold, deterioration of the display grace by interference or the joint can be prevented.

[0017] Moreover, any 2 patterns of the concavo-convex patterns of the specific class which this invention has two or more at least one kind of concavo-convex patterns, and has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the reflecting plate front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterized by being arranged in irregular. If this invention is followed, since, as for a reflecting plate, the pixels near the neighborhood have the concavo-convex pattern with which reflection properties differ by having relation which was mentioned above, display nonuniformity does not arise. Moreover, since change of a synchronous reflection property does not arise even when the parallelism of incident light is high, interference of the reflected light can be prevented certainly.

[0018] This invention has the insulating substrate of the pair arranged by intervening in a liquid crystal layer. Either moreover, to the liquid crystal layer side of an insulating substrate In the reflective mold liquid crystal display which reflects and carries out outgoing radiation of the light which carried out incidence with a pixel electrode from the another side insulation substrate side which two or more pixel electrodes which have light reflex nature arrange in the shape of a matrix, are arranged, and has translucency The front face of said pixel electrode is concave convex, and the concavo-convex pattern for 1 pixel is a reflective mold liquid crystal display characterized by there being two or more kinds. if this invention is followed, since a reflective mold liquid crystal display can make the luminous intensity scattered about in the direction of a watcher increase to incident light when two or more pixel electrodes which have the light reflex nature arranged in the shape of a matrix are arranged and each pixel electrode has a concave convex front face -- bright -- a paper -- a white display can be obtained. Moreover, when there are two or more kinds of concavo-convex patterns for 1 pixel, the abrupt change of a reflection property can be prevented and a joint does not occur. Moreover, since the reflection properties of each pixel differ even when the parallelism of incident light is high, the interference color can be prevented and display grace improves.

[0019] Moreover, any 2 patterns of the concavo-convex patterns of the specific class which this invention has two or more at least one kind of concavo-convex patterns, and has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the pixel electrode surface, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterized by being arranged in irregular. If this invention is followed, since, as for a pixel electrode, the pixel electrodes near the neighborhood have the concavo-convex pattern with which reflection properties differ by having relation which was mentioned above, display nonuniformity does not arise. Moreover, since change of a periodic reflection property does not arise even when the parallelism of incident light is high, interference of the reflected light can be prevented certainly.

[0020] Preferably moreover, in the liquid crystal layer side front face of the aforementioned one side insulation substrate The switching element which is arranged, respectively to the pixel field of the rectangle formed when two or more wiring which holds insulation mutually and intersects perpendicularly, and this wiring cross, and is connected to said wiring is formed. The insulating layer which furthermore covers a part of this wiring and switching element [ at least ], and has a concave convex front face is formed. It connects with each switching element individually through the through hole formed in this insulating layer, and said pixel electrode is formed on an insulating layer. In the liquid crystal layer side front face of said another side insulation substrate It is characterized by forming the counterelectrode which has the translucency which counters said pixel electrode. A reflective mold liquid crystal display Since the insulating layer which covers two or more wiring and a part of switching element [ at least ], and has a concave convex front face is formed and a pixel electrode is formed for every pixel field on an insulating layer, a pixel electrode concave convex in a front face is formed. The luminous intensity scattered about in the direction of a watcher to incident light with a pixel electrode over a large field can be made to increase. a pixel electrode is connected with a switching element through a through hole -- having -- a reflective liquid crystal display -- bright -- a paper -- a white display can be obtained.

[0021] Moreover, after forming the photopolymer film on the substrate which this invention is the manufacture approach of the reflecting plate used for the display of the light reflex mold which has two or more pixels arranged in the shape of a matrix, and is defined beforehand, the mask which has a predetermined pattern is minded. In the manufacture approach of a reflecting plate including the process which exposes the photopolymer film said mask It is the manufacture approach of the reflecting plate characterized by having two or more kinds of patterns for 1 pixel, moving this mask or said substrate, and including the process to develop after carrying out the count loop of predetermined of the process which exposes said photopolymer film. If this invention is followed, using the mask which has two or more kinds of concavo-convex patterns for a reflecting plate without a joint, multiple times can be exposed and it can create.



[0022] Moreover, any 2 patterns of the concavo-convex patterns of the specific class which this invention has two or more at least one kind of concavo-convex patterns of said mask, and has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the mask front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterize by be arrange in irregular. If this invention is followed, since a mask has two or more at least one kind of concavo-convex patterns, the design of a mask can be simplified. Moreover, by having relation which was mentioned above, the relation of any 2 patterns of them can form easily and certainly many concavo-convex patterns with which reflection properties differ, and can obtain the reflecting plate which has a good reflection property.

[0023] This invention has the insulating substrate of the pair arranged by intervening in a liquid crystal layer. Either moreover, to the liquid crystal layer side of an insulating substrate Two or more pixel electrodes which have light reflex nature arrange in the shape of a matrix, and are arranged. It is the manufacture approach of the reflective mold liquid crystal display which reflects and carries out outgoing radiation of the light which carried out incidence with a pixel electrode from the another side insulation substrate side which has translucency. After covering a part of switching element [ at least ] formed on the insulating substrate on the other hand and forming the photopolymer film on this one side insulation substrate, the mask which has a predetermined pattern is minded. In the manufacture approach of a reflecting plate mold liquid crystal display including the process which exposes the photopolymer film said mask After having two or more kinds of patterns for 1 pixel and carrying out the count loop of predetermined of this mask or said process which moves an insulating substrate on the other hand, and exposes said photopolymer film, it is the manufacture approach of the reflective mold liquid crystal display characterized by including the process to develop.

If this invention is followed, there is no generating of a joint, and using the mask which has two or more kinds of concavo-convex patterns for the reflective mold liquid crystal display whose display grace improved, multiple times can be exposed and it can create.

[0024] Moreover, any 2 patterns of the concavo-convex patterns of the specific class which this invention has two or more at least one kind of concavo-convex patterns of said mask, and has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the mask front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterize by be arrange in irregular. If this invention is followed, since a mask has two or more at least one kind of concavo-convex patterns, the design of a mask can be simplified. Moreover, by having relation which was mentioned above, the relation of any 2 patterns of them can form easily and certainly many concavo-convex patterns with which reflection properties differ, and can obtain the reflective mold liquid crystal display whose display grace improved.

[0025]

[Embodiment of the Invention] Drawing 1 is the top view showing mask 1a used for creation of the reflecting plate which is 1 operation gestalt of this invention, and a reflective mold liquid crystal display. Drawing 2 is drawing showing the relation of the concavo-convex pattern of said mask 1a. A reflecting plate is used for the display which has two or more pixels arranged in the shape of a matrix. Moreover, a reflective mold liquid crystal display has two or more pixels arranged in the shape of a matrix. Mask 1a has two or more kinds of concavo-convex patterns of each pixel 2. For example, each pixels 2a-2c have the concavo-convex patterns 3, 4, and 5 of a class different, respectively.

[0026] The circular field 6 which each concavo-convex patterns 3-5 have is for example, the optical protection-from-light section, and corresponds to the heights of the cylinder formed on the substrate which constitutes a reflecting plate and a display. Other other fields are the light transmission sections. The magnitude of the circular field 6 and arrangement are designed using CAD (Computer AidedDesign) so that arrangement of the heights of each pixel 2 on a substrate may become random. For example, when heights are formed, in order that the circular field 6 may prevent connection of \*\*\*\*\* heights, it has spacing of a minimum of 2 micrometers, and the gross area at the base of heights formed

in 2 1 pixel is designed so that 1-pixel about 80% of the whole surface product of 2 may be occupied. In addition, although this gestalt explains the example of three kinds of concavo-convex patterns 3-5, if it is two or more kinds, it is good without limit. However, it is desirable when about 3-5 kinds manufacture.

[0027] In order to give easy explanation of the concavo-convex pattern of said mask 1a, the concavo-convex patterns 3-5 are expressed with notations 7-9, respectively. Mask 1a has two or more each concavo-convex patterns 3-5, respectively. Moreover, any two concavo-convex patterns in the concavo-convex pattern of the same class which has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the front face of mask 1a, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are arranged at random.

[0028] And a parallel displacement is carried out. for example, the concavo-convex pattern of 2d of pixels -- the concavo-convex pattern of the notation 7 of pixel 2a -- front flesh-side reversal -- And a parallel displacement is carried out. the concavo-convex pattern of pixel 2e -- the concavo-convex pattern of the notation 8 of pixel 2b -- a rotation -- the concavo-convex pattern of 2f of pixels -- the concavo-convex pattern of the notation 9 of pixel 2c -- front flesh-side reversal and a rotation -- and a parallel displacement is carried out and the concavo-convex pattern of 2g of pixels carries out the parallel displacement of the concavo-convex pattern of the notation 7 of pixel 2a.

[0029] Thus, allocation and mask 1a are created for arrangement of heights about all the pixels 2 by designing the concavo-convex patterns 3-5 arranged at some kinds of random by CAD, and carrying out these concavo-convex patterns 3-5 for a parallel displacement, a rotation, front flesh-side reversal actuation, etc. By using some kinds of random concavo-convex patterns 3-5 two or more times, a large number formation of the concavo-convex pattern with which reflection properties differ can be carried out easily, and the design of mask 1a can be simplified. In addition, although this gestalt explained the example with all three kinds of two or more concavo-convex patterns 3-5, as long as there are two or more at least one kind of concavo-convex patterns and it has a relation which was mentioned above, you may be what kind of thing.

[0030] Drawing 3 is the sectional view showing gradually the manufacture approach of the reflecting plate 13 which is the 1st operation gestalt of this invention. A reflecting plate 13 is constituted including a substrate 10, heights 21, and the light reflex. film 22. As for a substrate 10, the glass substrate with a thickness of 1.1mm which consists of the trade name 7059 by Corning, Inc. whose vertical die length the horizontal die length is 320mm and is 400mm is used. a substrate 10 -- on the other hand -- a front face -- as the photopolymer film 17 -- for example, Tokyo -- adaptation -- shrine make -- the spin coat of the resist ingredient which consists of trade name OFPR-800 is carried out, and it is created. As for a spin coat, it is desirable to carry out at the rotational frequency of 500rpm - 3000rpm, for example, it performs the spin coat for 30 seconds by 1000rpm, and is formed by 1.2 micrometers in thickness. Then, heat treatment for 30 seconds is performed, for example at the temperature of 100 degrees C. As shown to drawing 3 (a) by this, the photopolymer film 17 is formed on a substrate 10.

[0031] Next, an exposure process is explained. On the other hand with reference to drawing 4 which is a perspective view for explaining the exposure process in the manufacture approach of a common reflecting plate, as for a substrate 10, diagonal length has each arrangement fields 11a and 12a for arranging the reflecting plate of 21.4cm 8.4 molds in two-sheet juxtaposition on a front face. Since there is a limit in the area which can be irradiated by one exposure, in exposing the substrate 10 exceeding the area which can irradiate at once, each arrangement fields 11a and 12a are equally divided into four, respectively, and it considers as exposure side A-D and E-H, and exposes in order.

[0032] On the substrate 10 with which the photopolymer film 17 was formed, as a mask 1, said mask 1a counters and is arranged for example, at the exposure side A. In the opposite side, the spherical exposure lamp 18 of stepper equipment is arranged in the substrate 10 of mask 1a. The exposure lamp 18 irradiates light 19 through mask 1a, and exposes the photopolymer film 17. Exposure side B-D and E-H are exposed in order by moving mask 1a or a substrate 10 after exposure of Field A, respectively. Mask 1a is not cared about, even if it is good, and it changes a front flesh side, for example and moving in

parallel also moves.

[0033] Drawing 3 (b) is the sectional view which expanded the substrate 10 with which the photopolymer film 17 of drawing 4 was formed, and the mask 1. The circular field 6 which mask 1a has is the optical protection-from-light section, and when the light 19 from said exposure lamp 18 penetrates fields other than circular field 6, the photopolymer film 17 is exposed. as a developer -- for example, Tokyo -- adaptation -- shrine make -- if negatives are developed using 2.38% solution of trade name NMD-3, as shown in drawing 3 (c), the detailed cylinder section 20 will be formed in the front face of a substrate 10. The configuration of the circle which the cylinder section 20 has corresponds to the circular field 6 of mask 1a.

[0034] The formed cylinder section 20 is heat-treated at the temperature of 120 degrees C - 250 degrees C. For example, if heat treatment for 30 minutes is performed at 180 degrees C, as shown in drawing 3 (d), the angle of the cylinder section 20 can be taken, and the heights 21 with a smooth front face will be formed. The light reflex film 22 which consists of a metal thin film as heights 21 are covered and it is shown in drawing 3 (e) all over a substrate 10 is formed. The light reflex film 22 is formed in 0.01 micrometers - 1.0 micrometers thickness by carrying out vacuum deposition of the aluminum. A reflection factor may form the light reflex film 22 using metals, such as nickel, Cr, Ag, etc. which thin film formation tends to perform highly.

[0035] A reflecting plate 13 is manufactured according to a process which was mentioned above. Of heights 21, the light reflex film 22 of a reflecting plate 13 has a curved surface [ \*\*\*\* ], and is formed in the shape of [ of conic loose boom hoisting ] toothing. A reflecting plate 13 can make the luminous intensity scattered about in the direction of a watcher increase to incident light with the light reflex film 22. Moreover, by mask 1a, since a reflecting plate 13 has the concavo-convex pattern with which \*\*\*\*\* each pixels 2 differed, the reflection properties of each pixel 2 differ and it can obtain a good reflection property.

[0036] Drawing 5 is drawing showing change of the reflection property of the reflecting plate 13 at the time of changing a location and exposing multiple times using said mask 1a. Drawing 5 (a) shows the pattern of a reflection property, and drawing 5 (b) shows change of the reflection property of the exposure side A and the exposure side B. Change of reflectivity is in the smallest condition, and a sign 29 expresses the condition that change of reflectivity becomes large gradually as it progresses to signs 30, 31, and 32.

[0037] The exposure sides A and B of a reflecting plate 13 are constituted by two or more pixels 2 which have a reflection property as shown with signs 29-32. A broken line 33 is a high line, such as expressing exposure intensity distribution with the exposure lamp 18. Field 33a is a part with strong exposure reinforcement, and exposure reinforcement becomes weak as it goes to Fields 33b and 33c. Since it is arranged so that the shape of toothing of pixel 2 comrades near the neighborhood may differ even if exposure nonuniformity as shown with a broken line 33 arises, the difference of a reflection property expressed with signs 29-32 is not continuous. Therefore, since a reflection property does not correspond to exposure nonuniformity, the abrupt change of a reflection property does not arise at the joint 28 of Field A and Field B. Consequently, when a reflecting plate 13 is used for a display, the line on the joint 28 which appeared in the conventional display stops being conspicuous, and display grace improves.

[0038] Drawing 6 is drawing showing the reflection property of the reflecting plate 13 when the parallelism of incident light is high. Since the reflecting plate 13 is arranged so that the shape of toothing of pixel 2 comrades near the neighborhood may differ, a difference produces it in a reflection property. It follows, for example, even if it is the case that the parallelism of incident light, such as sunlight, is high, change of a periodic reflection property does not arise in light 34. Since it is reflected in the various directions by different reflection property, even when a reflecting plate 13 is used for a display, the interference color is not observed but display grace of light 34 improves.

[0039] In addition, although the ingredient used for the photopolymer film 17 of said reflecting plate 13 explained the thing of POJITAIPU with this operation gestalt, as long as it can carry out patterning using a photolithography process at least irrespective of NEGATAIPU or POJITAIPU, it may be what

kind of ingredient. for example, Tokyo -- adaptation -- shrine make -- trade name OMR-83 and OMR-850, NNR-20, OFPR-2, OFPR-830, OFPR-5000, and the product made from Shipley -- trade name TF-20, 1300-27, 1400-27, trade name photograph NISU by Toray Industries, Inc., the trade name RW101 by the Sekisui fine chemical company, the trade names R101 and R633 by Nippon Kayaku Co., Ltd., etc. can be used. Moreover, the light transmission section of the pattern configuration of mask 1a which the photopolymer film 17 creates according to which type of POJITAIPU or NEGATAIPU it is corresponds, and is formed.

[0040] Moreover, a substrate 10 and the liquid crystal panel arrangement fields 11a and 12a are good as magnitude not only the magnitude shown with this gestalt but for obtaining 5 molds of 12.7cm of diagonal length as a liquid crystal panel, and a liquid crystal panel is not cared about as magnitude for creating only one on a substrate 10. The same effectiveness can be acquired even if it is such a case.

[0041] Drawing 7 is the sectional view showing the reflective mold liquid crystal display 35 which is the 2nd operation gestalt of this invention. Drawing 8 is the top view showing the substrate 39 used as substrate 39a which constitutes the reflective mold liquid crystal display 35, and the liquid crystal panels 11 and 12 of two sheets. Although the 1st operation gestalt explained the reflecting plate 13 which has a tothing-like front face, the 2nd operation gestalt explains the reflective mold liquid crystal display 35 in the guest host mode containing the reflective pixel electrode 48 which has a tothing-like front face.

[0042] On the other hand, the reflective mold liquid crystal display 35 is constituted including the substrate member 36, the another side substrate member 37, and the liquid crystal layer 38. The substrate 39 for substrate 39a which the substrate member 36 has on the other hand can arrange the liquid crystal panel of the 8.4 molds whose display diagonal length 16 the horizontal die length 14 is 320mm, the vertical die length 15 is 400mm, and is 214mm side by side to two-sheet juxtaposition, and one liquid crystal panel is equivalent to the reflective mold liquid crystal display 35. The fields 11 and 12 in which the area of the substrate 39 which can be irradiated by one exposure is equivalent to the liquid crystal panel on a substrate 39 since diagonal length is 12.7cm or less are equally divided into four, respectively, and are made into exposure side A-D and E-H, and each exposure side A-D and E-H are exposed in order.

[0043] On the other hand, two or more wiring with which the substrate member 36 holds insulation mutually, and intersects perpendicularly on glass substrate 39a which has insulation with a thickness of 1.1mm which consists of the trade name 7059 by Corning, Inc. is arranged, and the thin film transistor component (it is hereafter described as a "TFT component") 40 is formed in each pixel field of the rectangle formed when this wiring crosses as a switching element connected to said wiring, respectively. The TFT component 40 is constituted including the gate electrode 41, gate dielectric film 42, the semiconductor layer 43, the source electrode 44, the drain electrode 45, and the connection member 46.

[0044] Two or more wiring and a part of TFT component [ at least ] 40 are covered on substrate 39a, and the insulating layer 47 which has a tothing-like front face is formed of the same exposure as the 1st operation gestalt using said mask 1a. Two or more reflective pixel electrodes 48 which have a tothing-like front face on an insulating layer 47 are arranged in the shape of a matrix. It connects with the connection member 46 through each through hole 49 formed in the insulating layer 47, and the reflective pixel electrode 48 is further connected to the drain electrode 45 through the connection member 46. The orientation film ingredient which covers the reflective pixel electrode 48 and consists of for example, the Nissan chemistry company make and the polyimide resin of trade name SE-150 on an insulating layer 47 is applied by the spin coat method.

[0045] A color filter 52 is formed on the insulating substrate 51 with which the another side substrate member 37 has translucency. A color filter 52 is formed including red filter 52a arranged for every pixel, green filter 52b, and blue filter 52c. The flat film 53 is formed on a color filter 52, and the counterelectrode 54 which has the translucency which counters the reflective pixel electrode 48 is formed on it. Furthermore, an orientation film ingredient is applied by the spin coat method on it.

[0046] It is calcinated at the temperature of 180 degrees C after applying an orientation film ingredient, and rubbing processing is performed, and said substrates 39a and 51 are arranged as the substrate member 36 and the twist angle of the liquid crystal molecule between 37 become 240 degrees. It is

arranged face to face so that each reflective pixel electrode 48 and each filters 52a-52c may be in agreement, respectively, and the adhesives which mixed the 4.5-micrometer spacer are used, and substrate 39a and a substrate 51 are lamination \*\*\*\*. The guest host mold liquid crystal with which dichroic black coloring matter and 1.3% of chiral agent which consists of the Merck Co. make and a trade name S-811 were mixed in the pneumatic liquid crystal which consists of the Merck Co. make and a trade name ZLI4792 is used for the liquid crystal ingredient of the liquid crystal layer 38. using this chiral agent -- a ratio with the natural pitch  $P_o$  of the cel thickness  $d_o$  and a liquid crystal molecule --  $d_o/P_o$  is set to 0.9.

[0047] Since the difference of the reflection property of each reflective pixel electrode 48 is not continuous even when the front face of the reflective pixel electrode 48 changes a location and exposes multiple times by having the shape of toothing by mask 1a, at the joint of each exposure side A-D and E-H, the abrupt change of a reflection property does not arise like the 1st operation gestalt. Therefore, the line on a joint stops being conspicuous and display grace improves by the good reflection property.

[0048] Moreover, since light is reflected in the various directions by reflection property which change of a periodic reflection property does not arise but is different since it is arranged so that the shape of toothing of each reflective pixel electrode 48 near the neighborhood may change with mask 1a even when the parallelism of incident light is high, the interference color is not observed but display grace improves.

[0049] In addition, an opaque substrate like Si substrate with which the same effectiveness is demonstrated is sufficient as Substrates 39 and 39a, for example. When an opaque substrate is used, a circuit can be easily accumulated on a substrate 39 and 39a. Moreover, the reflective pixel electrode 48 formed on an insulating layer 47 may be formed on the TFT component 40 or wiring. In that case, a numerical aperture can improve and a bright display can be obtained.

[0050] Moreover, a reflective mold liquid crystal display is not restricted to guest host mode. Furthermore, it does not matter even if you may be a active-matrix mold using switching elements other than a TFT component and it is the passive-matrix mold which does not have a switching element.

[0051]

[Effect of the Invention] As mentioned above, according to this invention, by forming the front face corresponding to each pixel in the shape of toothing, a reflecting plate can prevent the abrupt change of a reflection property to the incident light from all include angles, when the luminous intensity scattered about in the direction of a watcher can be made to increase and there are two or more kinds of concavo-convex patterns for 1 pixel. Moreover, even when the parallelism of incident light is high, since the reflection properties of each pixel differ, interference of the reflected light can be prevented, and the good reflecting plate of a reflection property can be obtained. When it uses for the display of a light reflex mold, deterioration of the display grace by interference or the joint can be prevented.

[0052] According to this invention, moreover, any 2 patterns of the concavo-convex patterns of the specific class which a reflecting plate has two or more at least one kind of concavo-convex patterns, and has more than one By 1 or two or more relation of what carried out the parallel displacement mutually in the reflecting plate front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least And it is arranged in irregular, and when the pixels near the neighborhood certainly have the concavo-convex pattern with which reflection properties differ, display nonuniformity does not arise. Moreover, since change of a periodic reflection property does not arise even when the parallelism of incident light is high, interference of the reflected light can be prevented certainly.

[0053] Moreover, according to this invention, the reflective mold liquid crystal display which has a reflection property which was mentioned above can be realized, and the outstanding display grace which is a paper white brightly, does not have a joint and does not have the interference color can be acquired.

[0054] Moreover, according to this invention, with a concavo-convex pattern which was mentioned above, the interference color of a reflective mold liquid crystal display can be prevented further, and display grace can be raised.

[0055] Moreover, a reflective mold liquid crystal display can form a concave convex pixel electrode for

every pixel field on an insulating layer, and can make the luminous intensity scattered about in the direction of a watcher to incident light over a large field increase by forming the insulating layer which covers two or more wiring and a part of switching element [ at least ], and has a concave convex front face.

[0056] Moreover, according to this invention, a reflecting plate and a reflective mold liquid crystal display which were mentioned above can be created certainly and easily.

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[Translation done.]

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention is used for the display of a matrix mold, and relates to the reflective mold liquid crystal display which does not use the back light which displays by reflecting incident light in a pixel electrode surface, and its manufacture approach, concerning the reflecting plate and its manufacture approach for reflecting incident light.

[0002]

[Description of the Prior Art] Since the back light which is the light source is unnecessary, the reflective mold liquid crystal display which displays from the outside also in a liquid crystal display by reflecting the light which carried out incidence has low power consumption, and is a thin shape, and it is observed by lightweight-ization being attained. In order to obtain a still brighter display with a reflective mold liquid crystal display, the formation technique of a reflecting plate of having irregularity is important for the front face which needs to create the reflecting plate to which the luminous intensity scattered about in the direction of a watcher can be made to increase to incident light, and which has the optimal reflection property, and a paper white can realize.

[0003] The technique which forms irregularity on the surface of a reflecting plate with a photopolymer is indicated according to the photograph process by JP,5-323371,A. Drawing 9 is the top view showing the configuration of mask 1b of the conventional technique used in order to form irregularity on the surface of a reflecting plate. Drawing 9 (a) is the top view of mask 1b showing 61 [ 1-pixel ]. Drawing 9 (b) is drawing showing the arrangement relation of the unit pattern of mask 1b.

[0004] It is designed so that it may become irregular arrangement (random) of about 200 circular fields 62 in order to form the irregularity of mask 1b for the configuration of 61 to control 1 pixel of interference of the reflected light for example. The die length 63 of each side is the rectangle which is 100 micrometers - 1000 micrometers, and 61 expresses 1 pixel of the unit pattern with a notation 64. By repeating the unit pattern expressed with a notation 64 using mirror plane reversal, mask 1b opts for arrangement of the whole irregularity, and is designed.

[0005] Next, the production process of a reflecting plate which has irregularity is explained using mask 1b. Drawing 4 is a perspective view for explaining the exposure process in the manufacture approach of a common reflecting plate. The photopolymer film 17 is formed on the substrate 10 defined beforehand. The spherical exposure lamp 18 of stepper equipment is arranged in the photopolymer film 17 side upper part of a substrate 10, and the photopolymer film 17 is exposed through a mask 1. Since it is the case where diagonal length is about 12.7cm or less at the maximum in the present condition, when diagonal length creates reflecting plate about 12.7cm or more depending on the magnitude of the exposure lamp 18, the area which can be irradiated by one exposure moves the location of a mask 1 or a substrate 10, and repeats an exposure process the number of predetermined times. For example, the exposure side A is exposed by one exposure in a substrate 10. Then, different exposure side B-H is exposed by the target one by one by moving a mask 1 or a substrate 10, respectively. In the circular field 62 which mask 1b of the conventional technique used as a mask has, the field of the photopolymer film



[ / in addition to circular field 62 ] 17 is exposed by considering as the optical protection-from-light section.

[0006] The cylinder section will be formed in the field corresponding to the circular field 62 if the photopolymer film 17 after exposure is developed using a developer. The rough edge of the character of this cylinder section is rounded off by heat-treating at 120 degrees C - 250 degrees C, and it turns into heights with a smooth front face. The light reflex film which furthermore covers heights and consists of a metal thin film all over a substrate 10 is formed. Of heights, the light reflex film has a continuous curved surface, and is formed in the shape of [ of conic loose boom hoisting ] toothing. Thus, the luminous intensity which turns on a watcher increases the reflecting plate which has the shape of formed toothing, and when it uses for a reflective mold liquid crystal display, a paper white's bright display is obtained.

[0007]

[Problem(s) to be Solved by the Invention] 61 [ 1-pixel ] is used as a unit pattern, and mask 1b of the conventional technique is designed by [ which have the circular field 62 as mentioned above ] carrying out mirror plane reversal and repeating this unit pattern. Heights are formed in a reflecting plate of such mask 1b, and, as for the reflective mold liquid crystal display using this reflecting plate, a bright display is obtained in a paper white. However, by exposing two or more times, when a reflecting plate is large-sized, a reflection property falls and display grace falls with a display. The detail is explained below.

[0008] Drawing 10 is drawing showing exposure intensity distribution with the exposure lamp 18 of stepper equipment. It is expressed by the high line 24, such as expressing boom hoisting of the crest where a part with strong exposure reinforcement and a weak part are gently-sloping, by connecting with a curve the point that the exposure reinforcement of the field 23 which can be exposed is equal.

Exposure reinforcement becomes so weak [ it is so strong that an arrow head 25 progresses to a field 26 side, and ] that it progresses to a field 27 side. Since dispersion in about 3% of exposure reinforcement exists in the field 23 which can be exposed according to the difference of such exposure reinforcement, exposure nonuniformity arises.

[0009] Drawing 11 is drawing showing the optical intensity distribution at the time of changing a location and performing multiple-times exposure. For example, it exposes in order of the exposure sides A, B, C, and D, respectively. In exposure of Field A, although exposure reinforcement changes gently-sloping, when a location is changed and two exposure or more is performed, the exposure reinforcement of each joint 28 of a field and a field will change rapidly. The abrupt change of exposure reinforcement is observed as exposure nonuniformity.

[0010] Drawing 12 is the perspective view showing the difference in the configuration of the heights 21 by exposure reinforcement. Drawing 12 (a) shows the case where exposure reinforcement is strong, and drawing 12 (b) shows the case where exposure reinforcement is weak. Each cylinder section 20 formed in the front face of a substrate 10 becomes so thin that exposure reinforcement is strong. By heat-treating the cylinder section 20, the rough edge of the character is rounded off, and the projected part 21 with a smooth front face is formed. If [ height d of each heights 21 ] the same, its inclination is so sudden that the configuration of heights 21 has strong exposure reinforcement, and it is so gently-sloping that exposure reinforcement is weak. [ of inclination ] Thus, the configuration of heights 21 changes with exposure nonuniformity.

[0011] Drawing 13 is a graph which shows the difference in the reflection property of the heights 21 by exposure reinforcement. Drawing 13 (a) shows the case where exposure reinforcement is strong, and drawing 13 (b) shows the case where exposure reinforcement is weak. An axis of abscissa expresses whenever [ azimuth ] and the axis of ordinate expresses reflectivity. From a weak place, since the configuration of heights 21 changes, the place where exposure reinforcement is strong differs in reflectivity. The place where exposure reinforcement is strong has a small change of reflectivity over the large viewing-angle range, and, specifically, as for the place where exposure reinforcement is weak, change of the reflectivity in viewing-angle within the limits is large.

[0012] Drawing 14 is drawing showing change of the reflection property of the reflecting plate 71 at the time of changing a location and exposing multiple times using the conventional mask 1b. Drawing 14



(a) shows the pattern of a reflection property, and drawing 14 (b) shows the reflection property of the exposure side A and the exposure side B. Change of reflectivity is in the smallest condition, and a sign 65 expresses the condition that change of reflectivity becomes large gradually as it progresses to signs 66, 67, and 68. The exposure sides A and B are formed of two or more pixels 61 which have a reflection property as shown with signs 65-68. A broken line 69 is a high line, such as expressing exposure intensity distribution with said exposure lamp 18. Field 69a is a field where light exposure is strong, and light exposure becomes weak as it goes to Fields 69b and 69c. For example, the field A is exposed by the 1st exposure. In one exposure, since the shape of tothing changes gently-sloping continuously and a reflection property changes gently-sloping similarly in connection with it corresponding to the exposure nonuniformity shown with a broken line 69, the display nonuniformity by the interference color is not observed.

[0013] However, when exposure of multiple times, such as Field A and Field B, is performed, at the joint 70 of Field A and Field B, a concavo-convex configuration also changes with the abrupt changes of exposure reinforcement rapidly, for example. Consequently, since a reflection property changes rapidly at a joint 70, when the difference of a reflective distribution property displays by becoming the nonuniformity of brightness and being observed, the part of a joint 70 serves as a line, it is observed, and display grace falls.

[0014] Drawing 15 is drawing showing a reflection property when the parallelism of incident light is high in the conventional reflecting plate 71. Since the shape of tothing 72 and a reflection property serve as a repetition of the same pattern, when the parallelism of incident light is high, the parallelism of the reflected light also becomes high, the interference color by this reflected light is observed by repetition of a unit pattern with mask 1b same [ each pixel 61 of a reflecting plate 71 ], and display grace falls remarkably by it.

[0015] The purpose of this invention is offering the manufacture approach of offering the reflecting plate which solves an above-mentioned problem and has a good reflection property and offering the manufacture approach of this reflecting plate, the reflective mold liquid crystal display whose display grace's improves further, and this reflective mold liquid crystal display.

[0016]

[Means for Solving the Problem] In the reflecting plate with which this invention is used for the display of the light reflex mold which has two or more pixels arranged in the shape of a matrix, the field corresponding to each pixel on this front face of a reflecting plate is concave convex, and the concavo-convex pattern for 1 pixel is a reflecting plate characterized by there being two or more kinds. If this invention is followed, a reflecting plate is used for the display of the light reflex mold which has two or more pixels arranged in the shape of a matrix, and the luminous intensity scattered about in the direction of a watcher can be made to increase to incident light by forming the front face corresponding to each pixel in concave convex. Moreover, when there are two or more kinds of concavo-convex patterns for 1 pixel, the abrupt change of a reflection property can be prevented and a joint does not occur. Moreover, since the reflection properties of each pixel differ even when the parallelism of incident light is high, interference of the reflected light can be prevented and a good reflection property can be obtained. When it uses for the display of a light reflex mold, deterioration of the display grace by interference or the joint can be prevented.

[0017] Moreover, any 2 patterns of the concavo-convex patterns of the specific class which this invention has two or more at least one kind of concavo-convex patterns, and has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the reflecting plate front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterized by being arranged in irregular. If this invention is followed, since, as for a reflecting plate, the pixels near the neighborhood have the concavo-convex pattern with which reflection properties differ by having relation which was mentioned above, display nonuniformity does not arise. Moreover, since change of a synchronous reflection property does not arise even when the parallelism of incident light is high, interference of the reflected light can be prevented certainly.

[0018] This invention has the insulating substrate of the pair arranged by intervening in a liquid crystal layer. Either moreover, to the liquid crystal layer side of an insulating substrate In the reflective mold liquid crystal display which reflects and carries out outgoing radiation of the light which carried out incidence with a pixel electrode from the another side insulation substrate side which two or more pixel electrodes which have light reflex nature arrange in the shape of a matrix, are arranged, and has translucency The front face of said pixel electrode is concave convex, and the concavo-convex pattern for 1 pixel is a reflective mold liquid crystal display characterized by there being two or more kinds. if this invention is followed, since a reflective mold liquid crystal display can make the luminous intensity scattered about in the direction of a watcher increase to incident light when two or more pixel electrodes which have the light reflex nature arranged in the shape of a matrix are arranged and each pixel electrode has a concave convex front face -- bright -- a paper -- a white display can be obtained. Moreover, when there are two or more kinds of concavo-convex patterns for 1 pixel, the abrupt change of a reflection property can be prevented and a joint does not occur. Moreover, since the reflection properties of each pixel differ even when the parallelism of incident light is high, the interference color can be prevented and display grace improves.

[0019] Moreover, any 2 patterns of the concavo-convex patterns of the specific class which this invention has two or more at least one kind of concavo-convex patterns, and has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the pixel electrode surface, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterized by being arranged in irregular. If this invention is followed, since, as for a pixel electrode, the pixel electrodes near the neighborhood have the concavo-convex pattern with which reflection properties differ by having relation which was mentioned above, display nonuniformity does not arise. Moreover, since change of a periodic reflection property does not arise even when the parallelism of incident light is high, interference of the reflected light can be prevented certainly.

[0020] Preferably moreover, in the liquid crystal layer side front face of the aforementioned one side insulation substrate The switching element which is arranged, respectively to the pixel field of the rectangle formed when two or more wiring which holds insulation mutually and intersects perpendicularly, and this wiring cross, and is connected to said wiring is formed. The insulating layer which furthermore covers a part of this wiring and switching element [ at least ], and has a concave convex front face is formed. It connects with each switching element individually through the through hole formed in this insulating layer, and said pixel electrode is formed on an insulating layer. In the liquid crystal layer side front face of said another side insulation substrate It is characterized by forming the counterelectrode which has the translucency which counters said pixel electrode. A reflective mold liquid crystal display Since the insulating layer which covers two or more wiring and a part of switching element [ at least ], and has a concave convex front face is formed and a pixel electrode is formed for every pixel field on an insulating layer, a pixel electrode concave convex in a front face is formed. The luminous intensity scattered about in the direction of a watcher to incident light with a pixel electrode over a large field can be made to increase. a pixel electrode is connected with a switching element through a through hole -- having -- a reflective liquid crystal display -- bright -- a paper -- a white display can be obtained.

[0021] Moreover, after forming the photopolymer film on the substrate which this invention is the manufacture approach of the reflecting plate used for the display of the light reflex mold which has two or more pixels arranged in the shape of a matrix, and is defined beforehand, the mask which has a predetermined pattern is minded. In the manufacture approach of a reflecting plate including the process which exposes the photopolymer film said mask It is the manufacture approach of the reflecting plate characterized by having two or more kinds of patterns for 1 pixel, moving this mask or said substrate, and including the process to develop after carrying out the count loop of predetermined of the process which exposes said photopolymer film. If this invention is followed, using the mask which has two or more kinds of concavo-convex patterns for a reflecting plate without a joint, multiple times can be exposed and it can create.

[0022] Moreover, any 2 patterns of the concavo-convex patterns of the specific class which this invention has two or more at least one kind of concavo-convex patterns of said mask, and has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the mask front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterize by be arrange in irregular. If this invention is followed, since a mask has two or more at least one kind of concavo-convex patterns, the design of a mask can be simplified. Moreover, by having relation which was mentioned above, the relation of any 2 patterns of them can form easily and certainly many concavo-convex patterns with which reflection properties differ, and can obtain the reflecting plate which has a good reflection property.

[0023] This invention has the insulating substrate of the pair arranged by intervening in a liquid crystal layer. Either moreover, to the liquid crystal layer side of an insulating substrate Two or more pixel electrodes which have light reflex nature arrange in the shape of a matrix, and are arranged. It is the manufacture approach of the reflective mold liquid crystal display which reflects and carries out outgoing radiation of the light which carried out incidence with a pixel electrode from the another side insulation substrate side which has translucency. After covering a part of switching element [ at least ] formed on the insulating substrate on the other hand and forming the photopolymer film on this one side insulation substrate, the mask which has a predetermined pattern is minded. In the manufacture approach of a reflecting plate mold liquid crystal display including the process which exposes the photopolymer film said mask After having two or more kinds of patterns for 1 pixel and carrying out the count loop of predetermined of this mask or said process which moves an insulating substrate on the other hand, and exposes said photopolymer film, it is the manufacture approach of the reflective mold liquid crystal display characterized by including the process to develop.

If this invention is followed, there is no generating of a joint, and using the mask which has two or more kinds of concavo-convex patterns for the reflective mold liquid crystal display whose display grace improved, multiple times can be exposed and it can create.

[0024] Moreover, any 2 patterns of the concavo-convex patterns of the specific class which this invention has two or more at least one kind of concavo-convex patterns of said mask, and has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the mask front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are characterize by be arrange in irregular. If this invention is followed, since a mask has two or more at least one kind of concavo-convex patterns, the design of a mask can be simplified. Moreover, by having relation which was mentioned above, the relation of any 2 patterns of them can form easily and certainly many concavo-convex patterns with which reflection properties differ, and can obtain the reflective mold liquid crystal display whose display grace improved.

[0025]

[Embodiment of the Invention] Drawing 1 is the top view showing mask 1a used for creation of the reflecting plate which is 1 operation gestalt of this invention, and a reflective mold liquid crystal display. Drawing 2 is drawing showing the relation of the concavo-convex pattern of said mask 1a. A reflecting plate is used for the display which has two or more pixels arranged in the shape of a matrix. Moreover, a reflective mold liquid crystal display has two or more pixels arranged in the shape of a matrix. Mask 1a has two or more kinds of concavo-convex patterns of each pixel 2. For example, each pixels 2a-2c have the concavo-convex patterns 3, 4, and 5 of a class different, respectively.

[0026] The circular field 6 which each concavo-convex patterns 3-5 have is for example, the optical protection-from-light section, and corresponds to the heights of the cylinder formed on the substrate which constitutes a reflecting plate and a display. Other other fields are the light transmission sections. The magnitude of the circular field 6 and arrangement are designed using CAD (Computer AidedDesign) so that arrangement of the heights of each pixel 2 on a substrate may become random. For example, when heights are formed, in order that the circular field 6 may prevent connection of \*\*\*\*\* heights, it has spacing of a minimum of 2 micrometers, and the gross area at the base of heights formed

in 2 1 pixel is designed so that 1-pixel about 80% of the whole surface product of 2 may be occupied. In addition, although this gestalt explains the example of three kinds of concavo-convex patterns 3-5, if it is two or more kinds, it is good without limit. However, it is desirable when about 3-5 kinds manufacture.

[0027] In order to give easy explanation of the concavo-convex pattern of said mask 1a, the concavo-convex patterns 3-5 are expressed with notations 7-9, respectively. Mask 1a has two or more each concavo-convex patterns 3-5, respectively. Moreover, any two concavo-convex patterns in the concavo-convex pattern of the same class which has more than one are 1 or two or more relation of what carried out the parallel displacement mutually in the front face of mask 1a, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least, and are arranged at random.

[0028] And a parallel displacement is carried out. for example, the concavo-convex pattern of 2d of pixels -- the concavo-convex pattern of the notation 7 of pixel 2a -- front flesh-side reversal -- And a parallel displacement is carried out. the concavo-convex pattern of pixel 2e -- the concavo-convex pattern of the notation 8 of pixel 2b -- a rotation -- the concavo-convex pattern of 2f of pixels -- the concavo-convex pattern of the notation 9 of pixel 2c -- front flesh-side reversal and a rotation -- and a parallel displacement is carried out and the concavo-convex pattern of 2g of pixels carries out the parallel displacement of the concavo-convex pattern of the notation 7 of pixel 2a.

[0029] Thus, allocation and mask 1a are created for arrangement of heights about all the pixels 2 by designing the concavo-convex patterns 3-5 arranged at some kinds of random by CAD, and carrying out these concavo-convex patterns 3-5 for a parallel displacement, a rotation, front flesh-side reversal actuation, etc. By using some kinds of random concavo-convex patterns 3-5 two or more times, a large number formation of the concavo-convex pattern with which reflection properties differ can be carried out easily, and the design of mask 1a can be simplified. In addition, although this gestalt explained the example with all three kinds of two or more concavo-convex patterns 3-5, as long as there are two or more at least one kind of concavo-convex patterns and it has a relation which was mentioned above, you may be what kind of thing.

[0030] Drawing 3 is the sectional view showing gradually the manufacture approach of the reflecting plate 13 which is the 1st operation gestalt of this invention. A reflecting plate 13 is constituted including a substrate 10, heights 21, and the light reflex film 22. As for a substrate 10, the glass substrate with a thickness of 1.1mm which consists of the trade name 7059 by Corning, Inc. whose vertical die length the horizontal die length is 320mm and is 400mm is used. a substrate 10 -- on the other hand -- a front face -- as the photopolymer film 17 -- for example, Tokyo -- adaptation -- shrine make -- the spin coat of the resist ingredient which consists of trade name OFPR-800 is carried out, and it is created. As for a spin coat, it is desirable to carry out at the rotational frequency of 500rpm - 3000rpm, for example, it performs the spin coat for 30 seconds by 1000rpm, and is formed by 1.2 micrometers in thickness. Then, heat treatment for 30 seconds is performed, for example at the temperature of 100 degrees C. As shown to drawing 3 (a) by this, the photopolymer film 17 is formed on a substrate 10.

[0031] Next, an exposure process is explained. On the other hand with reference to drawing 4 which is a perspective view for explaining the exposure process in the manufacture approach of a common reflecting plate, as for a substrate 10, diagonal length has each arrangement fields 11a and 12a for arranging the reflecting plate of 21.4cm 8.4 molds in two-sheet juxtaposition on a front face. Since there is a limit in the area which can be irradiated by one exposure, in exposing the substrate 10 exceeding the area which can irradiate at once, each arrangement fields 11a and 12a are equally divided into four, respectively, and it considers as exposure side A-D and E-H, and exposes in order.

[0032] On the substrate 10 with which the photopolymer film 17 was formed, as a mask 1, said mask 1a counters and is arranged for example, at the exposure side A. In the opposite side, the spherical exposure lamp 18 of stepper equipment is arranged in the substrate 10 of mask 1a. The exposure lamp 18 irradiates light 19 through mask 1a, and exposes the photopolymer film 17. Exposure side B-D and E-H are exposed in order by moving mask 1a or a substrate 10 after exposure of Field A, respectively. Mask 1a is not cared about, even if it is good, and it changes a front flesh side, for example and moving in

parallel also moves.

[0033] Drawing 3 (b) is the sectional view which expanded the substrate 10 with which the photopolymer film 17 of drawing 4 was formed, and the mask 1. The circular field 6 which mask 1a has is the optical protection-from-light section, and when the light 19 from said exposure lamp 18 penetrates fields other than circular field 6, the photopolymer film 17 is exposed. as a developer -- for example, Tokyo -- adaptation -- shrine make -- if negatives are developed using 2.38% solution of trade name NMD-3, as shown in drawing 3 (c), the detailed cylinder section 20 will be formed in the front face of a substrate 10. The configuration of the circle which the cylinder section 20 has corresponds to the circular field 6 of mask 1a.

[0034] The formed cylinder section 20 is heat-treated at the temperature of 120 degrees C - 250 degrees C. For example, if heat treatment for 30 minutes is performed at 180 degrees C, as shown in drawing 3 (d), the angle of the cylinder section 20 can be taken, and the heights 21 with a smooth front face will be formed. The light reflex film 22 which consists of a metal thin film as heights 21 are covered and it is shown in drawing 3 (e) all over a substrate 10 is formed. The light reflex film 22 is formed in 0.01 micrometers - 1.0 micrometers thickness by carrying out vacuum deposition of the aluminum. A reflection factor may form the light reflex film 22 using metals, such as nickel, Cr, Ag, etc. which thin film formation tends to perform highly.

[0035] A reflecting plate 13 is manufactured according to a process which was mentioned above. Of heights 21, the light reflex film 22 of a reflecting plate 13 has a curved surface [ \*\*\*\* ], and is formed in the shape of [ of conic loose boom hoisting ] toothing. A reflecting plate 13 can make the luminous intensity scattered about in the direction of a watcher increase to incident light with the light reflex film 22. Moreover, by mask 1a, since a reflecting plate 13 has the concavo-convex pattern with which \*\*\*\*\* each pixels 2 differed, the reflection properties of each pixel 2 differ and it can obtain a good reflection property.

[0036] Drawing 5 is drawing showing change of the reflection property of the reflecting plate 13 at the time of changing a location and exposing multiple times using said mask 1a. Drawing 5 (a) shows the pattern of a reflection property, and drawing 5 (b) shows change of the reflection property of the exposure side A and the exposure side B. Change of reflectivity is in the smallest condition, and a sign 29 expresses the condition that change of reflectivity becomes large gradually as it progresses to signs 30, 31, and 32.

[0037] The exposure sides A and B of a reflecting plate 13 are constituted by two or more pixels 2 which have a reflection property as shown with signs 29-32. A broken line 33 is a high line, such as expressing exposure intensity distribution with the exposure lamp 18. Field 33a is a part with strong exposure reinforcement, and exposure reinforcement becomes weak as it goes to Fields 33b and 33c. Since it is arranged so that the shape of toothing of pixel 2 comrades near the neighborhood may differ even if exposure nonuniformity as shown with a broken line 33 arises, the difference of a reflection property expressed with signs 29-32 is not continuous. Therefore, since a reflection property does not correspond to exposure nonuniformity, the abrupt change of a reflection property does not arise at the joint 28 of Field A and Field B. Consequently, when a reflecting plate 13 is used for a display, the line on the joint 28 which appeared in the conventional display stops being conspicuous, and display grace improves.

[0038] Drawing 6 is drawing showing the reflection property of the reflecting plate 13 when the parallelism of incident light is high. Since the reflecting plate 13 is arranged so that the shape of toothing of pixel 2 comrades near the neighborhood may differ, a difference produces it in a reflection property. It follows, for example, even if it is the case that the parallelism of incident light, such as sunlight, is high, change of a periodic reflection property does not arise in light 34. Since it is reflected in the various directions by different reflection property, even when a reflecting plate 13 is used for a display, the interference color is not observed but display grace of light 34 improves.

[0039] In addition, although the ingredient used for the photopolymer film 17 of said reflecting plate 13 explained the thing of POJITAIPU with this operation gestalt, as long as it can carry out patterning using a photolithography process at least irrespective of NEGATAIPU or POJITAIPU, it may be what

kind of ingredient. for example, Tokyo -- adaptation -- shrine make -- trade name OMR-83 and OMR-850, NNR-20, OFPR-2, OFPR-830, OFPR-5000, and the product made from Shipley -- trade name TF-20, 1300-27, 1400-27, trade name photograph NISU by Toray Industries, Inc., the trade name RW101 by the Sekisui fine chemical company, the trade names R101 and R633 by Nippon Kayaku Co., Ltd., etc. can be used. Moreover, the light transmission section of the pattern configuration of mask 1a which the photopolymer film 17 creates according to which type of POJITAIPU or NEGATAIPU it is corresponds, and is formed.

[0040] Moreover, a substrate 10 and the liquid crystal panel arrangement fields 11a and 12a are good as magnitude not only the magnitude shown with this gestalt but for obtaining 5 molds of 12.7cm of diagonal length as a liquid crystal panel, and a liquid crystal panel is not cared about as magnitude for creating only one on a substrate 10. The same effectiveness can be acquired even if it is such a case.

[0041] Drawing 7 is the sectional view showing the reflective mold liquid crystal display 35 which is the 2nd operation gestalt of this invention. Drawing 8 is the top view showing the substrate 39 used as substrate 39a which constitutes the reflective mold liquid crystal display 35, and the liquid crystal panels 11 and 12 of two sheets. Although the 1st operation gestalt explained the reflecting plate 13 which has a tothing-like front face, the 2nd operation gestalt explains the reflective mold liquid crystal display 35 in the guest host mode containing the reflective pixel electrode 48 which has a tothing-like front face.

[0042] On the other hand, the reflective mold liquid crystal display 35 is constituted including the substrate member 36, the another side substrate member 37, and the liquid crystal layer 38. The substrate 39 for substrate 39a which the substrate member 36 has on the other hand can arrange the liquid crystal panel of the 8.4 molds whose display diagonal length 16 the horizontal die length 14 is 320mm, the vertical die length 15 is 400mm, and is 214mm side by side to two-sheet juxtaposition, and one liquid crystal panel is equivalent to the reflective mold liquid crystal display 35. The fields 11 and 12 in which the area of the substrate 39 which can be irradiated by one exposure is equivalent to the liquid crystal panel on a substrate 39 since diagonal length is 12.7cm or less are equally divided into four, respectively, and are made into exposure side A-D and E-H, and each exposure side A-D and E-H are exposed in order.

[0043] On the other hand, two or more wiring with which the substrate member 36 holds insulation mutually, and intersects perpendicularly on glass substrate 39a which has insulation with a thickness of 1.1mm which consists of the trade name 7059 by Corning, Inc. is arranged, and the thin film transistor component (it is hereafter described as a "TFT component") 40 is formed in each pixel field of the rectangle formed when this wiring crosses as a switching element connected to said wiring, respectively. The TFT component 40 is constituted including the gate electrode 41, gate dielectric film 42, the semiconductor layer 43, the source electrode 44, the drain electrode 45, and the connection member 46.

[0044] Two or more wiring and a part of TFT component [ at least ] 40 are covered on substrate 39a, and the insulating layer 47 which has a tothing-like front face is formed of the same exposure as the 1st operation gestalt using said mask 1a. Two or more reflective pixel electrodes 48 which have a tothing-like front face on an insulating layer 47 are arranged in the shape of a matrix. It connects with the connection member 46 through each through hole 49 formed in the insulating layer 47, and the reflective pixel electrode 48 is further connected to the drain electrode 45 through the connection member 46. The orientation film ingredient which covers the reflective pixel electrode 48 and consists of for example, the Nissan chemistry company make and the polyimide resin of trade name SE-150 on an insulating layer 47 is applied by the spin coat method.

[0045] A color filter 52 is formed on the insulating substrate 51 with which the another side substrate member 37 has translucency. A color filter 52 is formed including red filter 52a arranged for every pixel, green filter 52b, and blue filter 52c. The flat film 53 is formed on a color filter 52, and the counterelectrode 54 which has the translucency which counters the reflective pixel electrode 48 is formed on it. Furthermore, an orientation film ingredient is applied by the spin coat method on it.

[0046] It is calcinated at the temperature of 180 degrees C after applying an orientation film ingredient, and rubbing processing is performed, and said substrates 39a and 51 are arranged as the substrate member 36 and the twist angle of the liquid crystal molecule between 37 become 240 degrees. It is



arranged face to face so that each reflective pixel electrode 48 and each filters 52a-52c may be in agreement, respectively, and the adhesives which mixed the 4.5-micrometer spacer are used, and substrate 39a and a substrate 51 are lamination \*\*\*\*. The guest host mold liquid crystal with which dichroic black coloring matter and 1.3% of chiral agent which consists of the Merck Co. make and a trade name S-811 were mixed in the pneumatic liquid crystal which consists of the Merck Co. make and a trade name ZLI4792 is used for the liquid crystal ingredient of the liquid crystal layer 38. using this chiral agent -- a ratio with the natural pitch  $P_o$  of the cel thickness  $d_o$  and a liquid crystal molecule --  $d_o/P_o$  is set to 0.9.

[0047] Since the difference of the reflection property of each reflective pixel electrode 48 is not continuous even when the front face of the reflective pixel electrode 48 changes a location and exposes multiple times by having the shape of toothing by mask 1a, at the joint of each exposure side A-D and E-H, the abrupt change of a reflection property does not arise like the 1st operation gestalt. Therefore, the line on a joint stops being conspicuous and display grace improves by the good reflection property.

[0048] Moreover, since light is reflected in the various directions by reflection property which change of a periodic reflection property does not arise but is different since it is arranged so that the shape of toothing of each reflective pixel electrode 48 near the neighborhood may change with mask 1a even when the parallelism of incident light is high, the interference color is not observed but display grace improves.

[0049] In addition, an opaque substrate like Si substrate with which the same effectiveness is demonstrated is sufficient as Substrates 39 and 39a, for example. When an opaque substrate is used, a circuit can be easily accumulated on a substrate 39 and 39a. Moreover, the reflective pixel electrode 48 formed on an insulating layer 47 may be formed on the TFT component 40 or wiring. In that case, a numerical aperture can improve and a bright display can be obtained.

[0050] Moreover, a reflective mold liquid crystal display is not restricted to guest host mode. Furthermore, it does not matter even if you may be a active-matrix mold using switching elements other than a TFT component and it is the passive-matrix mold which does not have a switching element.

[0051]

[Effect of the Invention] As mentioned above, according to this invention, by forming the front face corresponding to each pixel in the shape of toothing, a reflecting plate can prevent the abrupt change of a reflection property to the incident light from all include angles, when the luminous intensity scattered about in the direction of a watcher can be made to increase and there are two or more kinds of concavo-convex patterns for 1 pixel. Moreover, even when the parallelism of incident light is high, since the reflection properties of each pixel differ, interference of the reflected light can be prevented, and the good reflecting plate of a reflection property can be obtained. When it uses for the display of a light reflex mold, deterioration of the display grace by interference or the joint can be prevented.

[0052] According to this invention, moreover, any 2 patterns of the concavo-convex patterns of the specific class which a reflecting plate has two or more at least one kind of concavo-convex patterns, and has more than one By 1 or two or more relation of what carried out the parallel displacement mutually in the reflecting plate front face, the thing which made it rotate, and the things which carried out front flesh-side reversal which include a parallel displacement at least And it is arranged in irregular, and when the pixels near the neighborhood certainly have the concavo-convex pattern with which reflection properties differ, display nonuniformity does not arise. Moreover, since change of a periodic reflection property does not arise even when the parallelism of incident light is high, interference of the reflected light can be prevented certainly.

[0053] Moreover, according to this invention, the reflective mold liquid crystal display which has a reflection property which was mentioned above can be realized, and the outstanding display grace which is a paper white brightly, does not have a joint and does not have the interference color can be acquired.

[0054] Moreover, according to this invention, with a concavo-convex pattern which was mentioned above, the interference color of a reflective mold liquid crystal display can be prevented further, and display grace can be raised.

[0055] Moreover, a reflective mold liquid crystal display can form a concave convex pixel electrode for

every pixel field on an insulating layer, and can make the luminous intensity scattered about in the direction of a watcher to incident light over a large field increase by forming the insulating layer which covers two or more wiring and a part of switching element [ at least ], and has a concave convex front face.

[0056] Moreover, according to this invention, a reflecting plate and a reflective mold liquid crystal display which were mentioned above can be created certainly and easily.

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[Translation done.]



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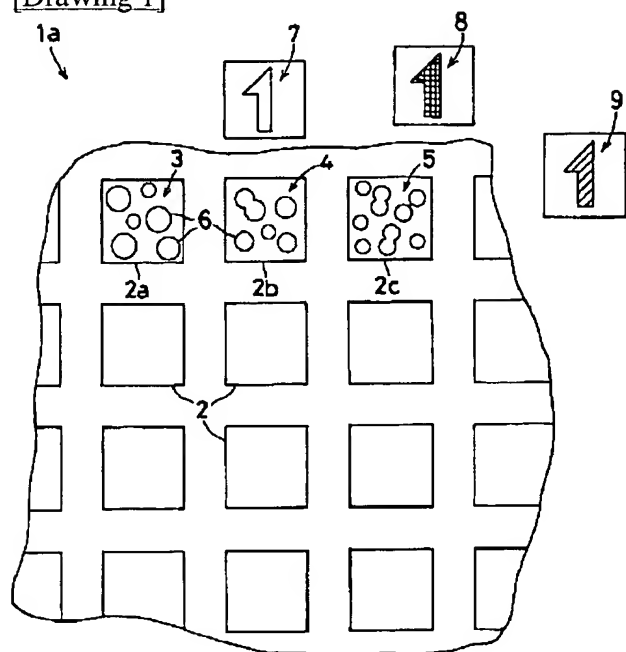
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2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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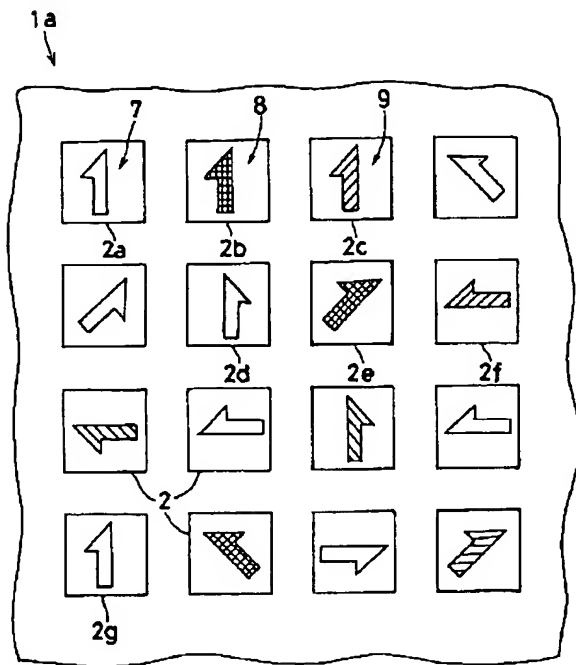
DRAWINGS

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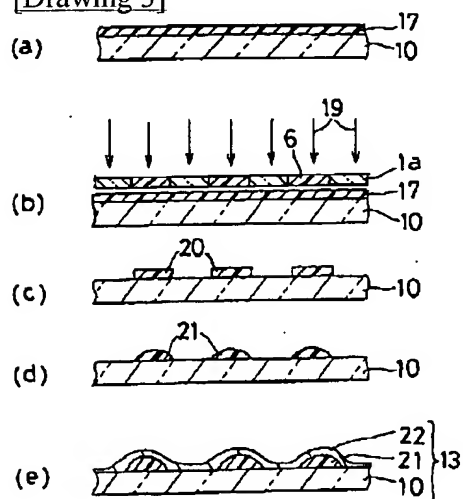
[Drawing 1]



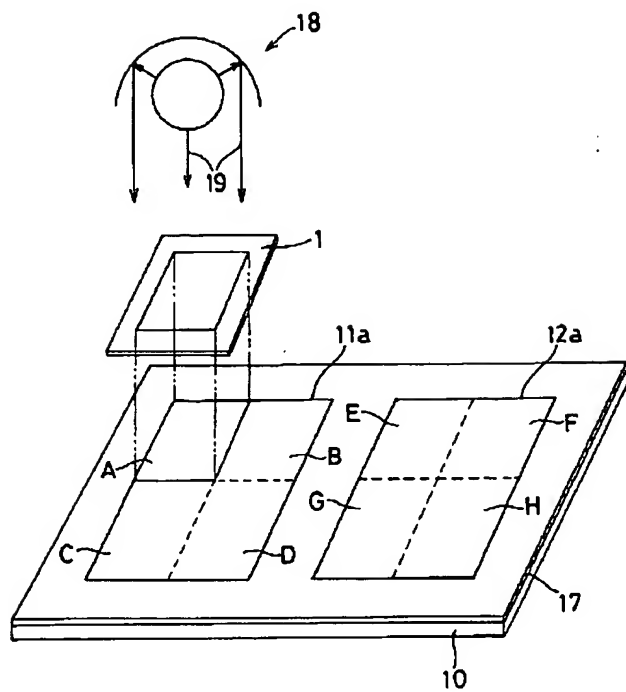
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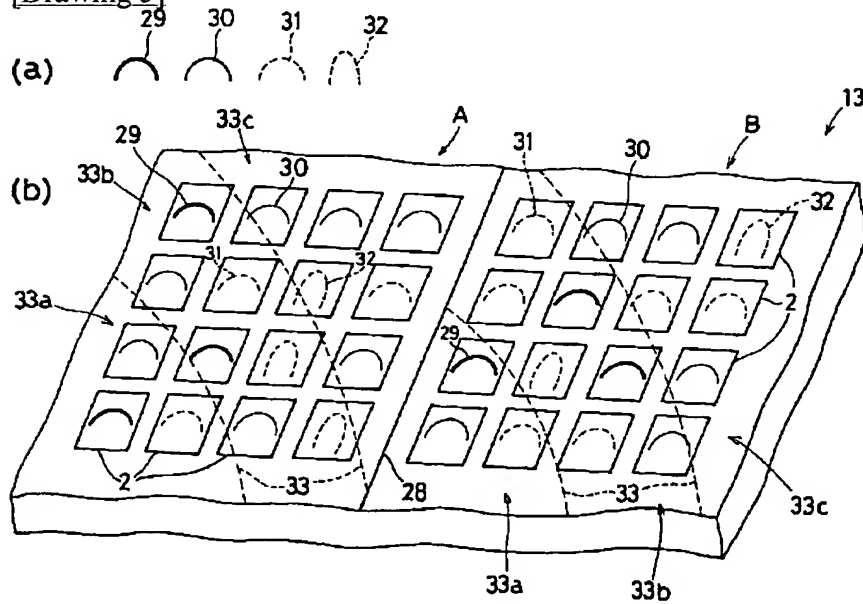
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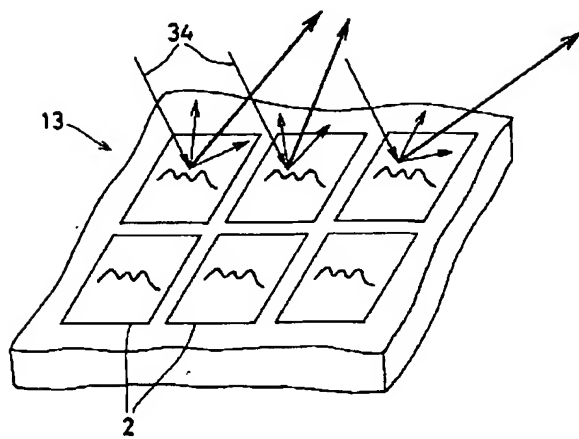
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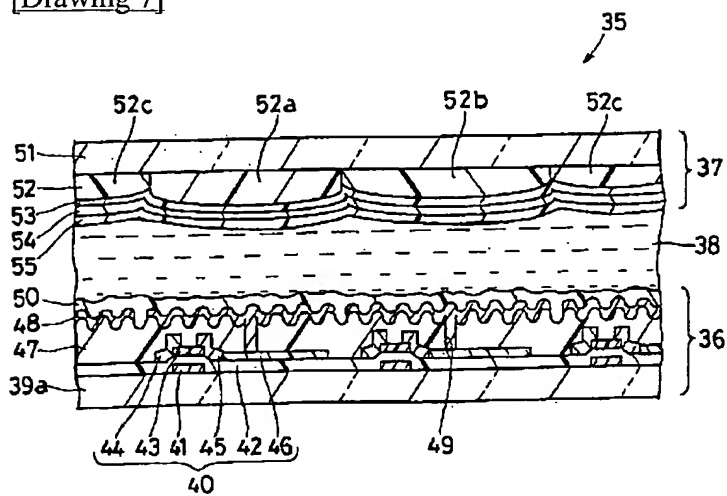
[Drawing 5]



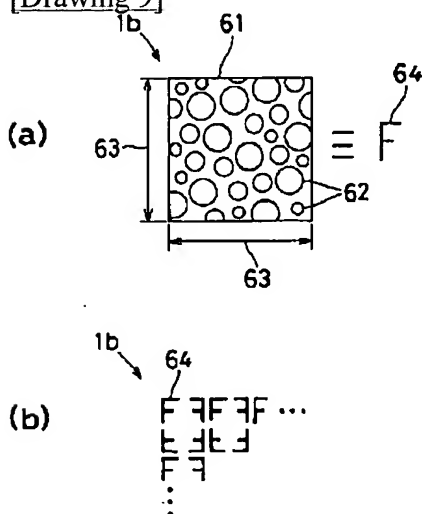
[Drawing 6]



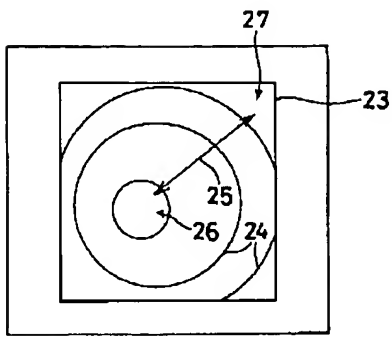
[Drawing 7]



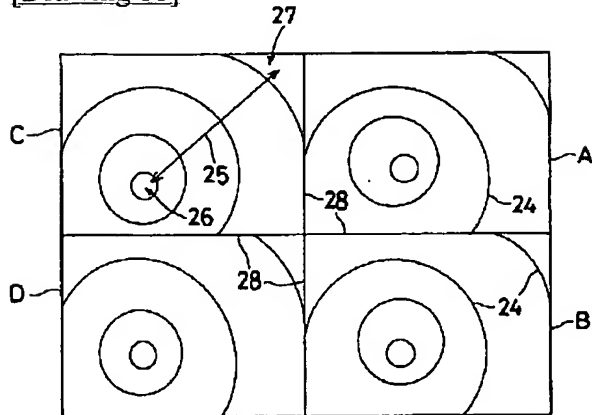
[Drawing 9]



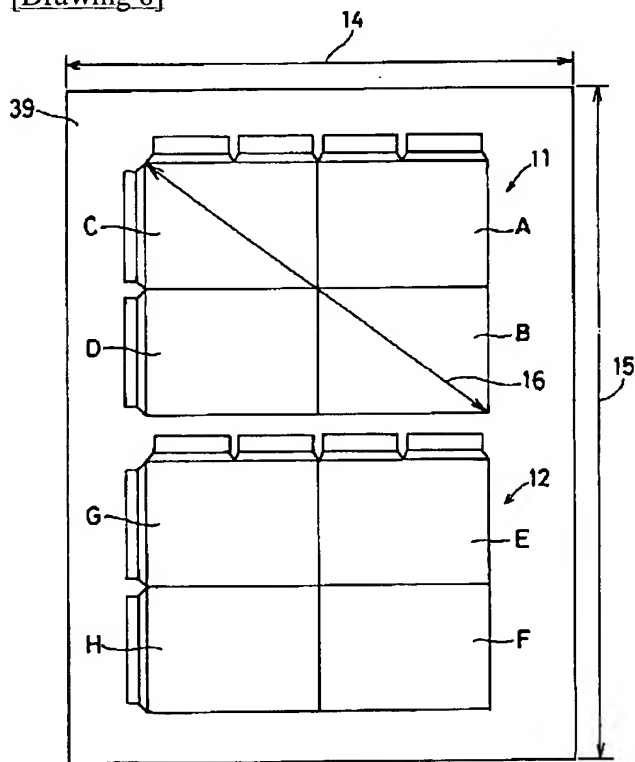
[Drawing 10]



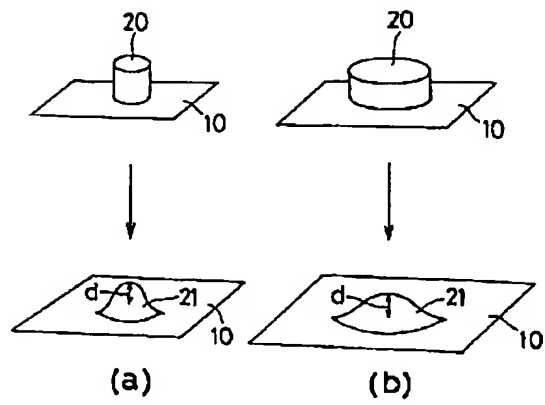
[Drawing 11]



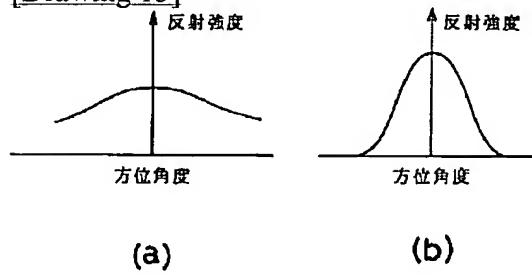
[Drawing 8]



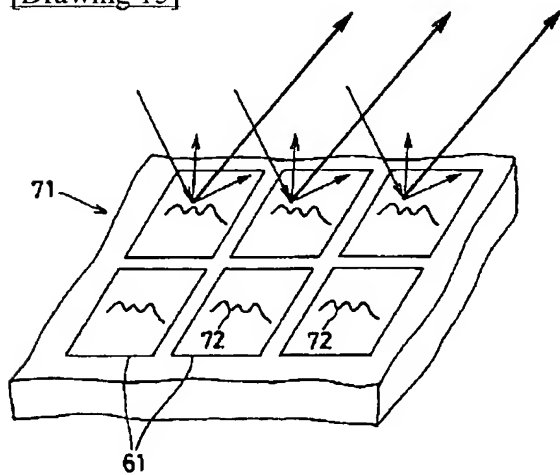
[Drawing 12]



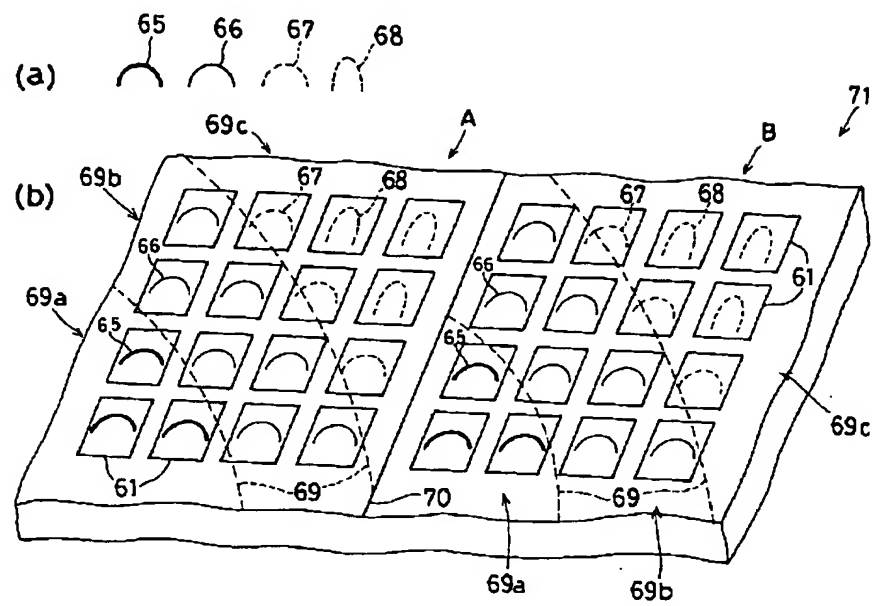
[Drawing 13]



[Drawing 15]



[Drawing 14]



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